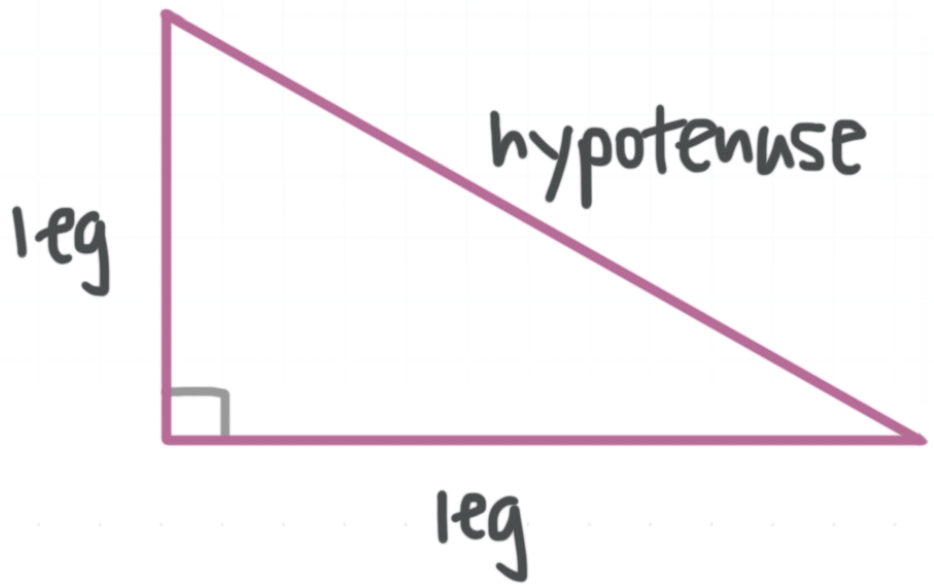
Pythagorean Theorem

In this lesson we'll look at how to use the Pythagorean Theorem to find the missing side of a triangle.

Parts of a right triangle

The sides touching the right angle are called legs of the right triangle and the side opposite of the right angle is called the hypotenuse.



Pythagorean Theorem

The Pythagorean Theorem shows how the side lengths of a right triangle are related to one another. It says that the sum of the squared lengths of each leg is equal to the square of the hypotenuse. Usually you see it written as

$$a^2 + b^2 = c^2$$

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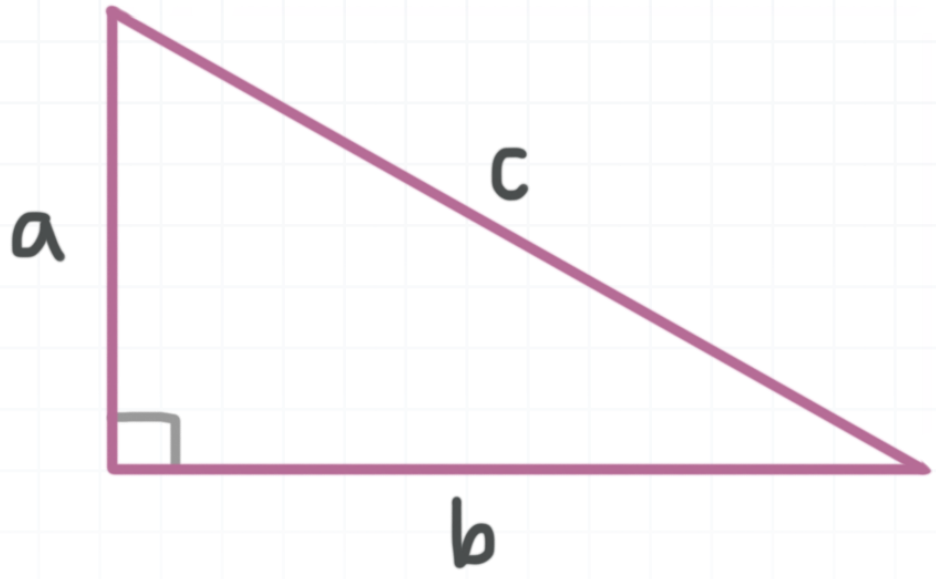
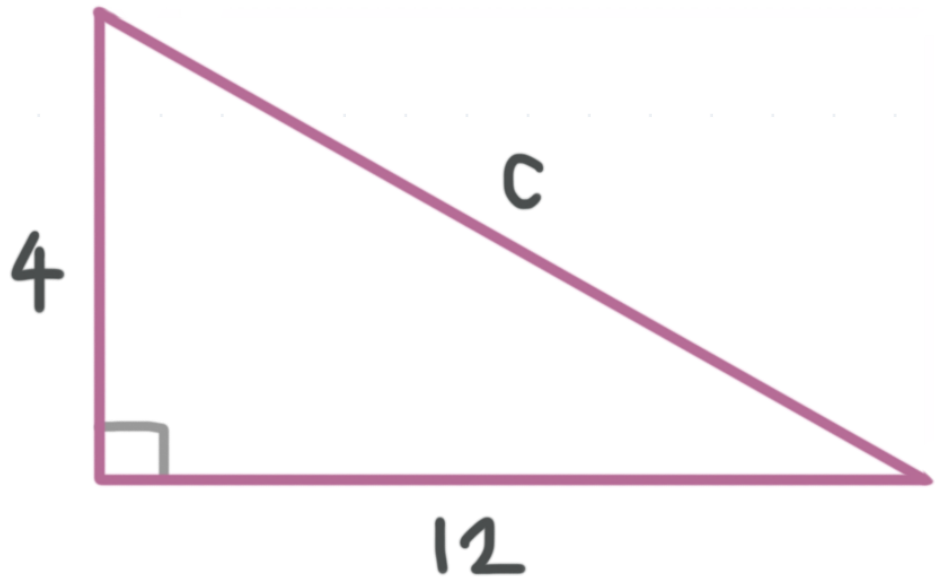
You can choose which leg to call leg a or leg b, but the hypotenuse of the triangle is always labeled c.



Let's start by working through an example.

Example

Find the length of the hypotenuse.



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Since this is a right triangle and we already know the length of two of the sides, we can use the Pythagorean Theorem to find the length of the third side. The Pythagorean Theorem is

$$a^2 + b^2 = c^2$$

Plugging in the dimensions of the triangle we've been given, we get

$$4^2 + 12^2 = c^2$$

$$16 + 144 = c^2$$

$$160 = c^2$$

$$c = \sqrt{16 \cdot 10}$$

$$c = 4\sqrt{10}$$

Sometimes a problem will use confusing variables just to throw you off, so be careful.

Example

Find the length of side c.

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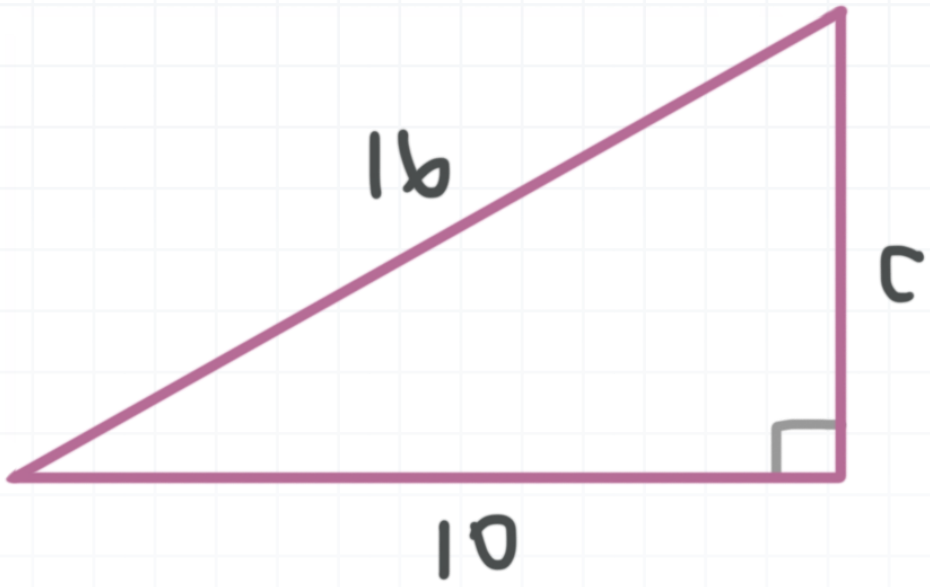
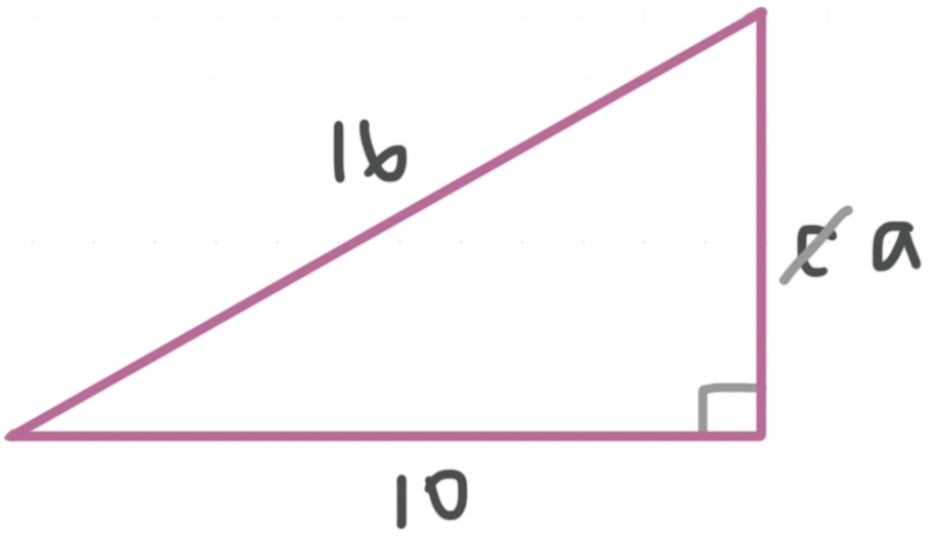


Since this is a right triangle and we already know the length of two of the sides, we can use the Pythagorean Theorem to find the length of the third side. The only thing we need to watch for is that the side labeled c is not the hypotenuse. Let's call it side a since it's a leg.



The Pythagorean Theorem is

$$a^2 + b^2 = c^2$$

Plugging in the dimensions of the triangle we've been given, we get

$$a^2 + 10^2 = 16^2$$

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$$a^2 + 100 = 256$$

$$a^2 = 156$$

$$a = \sqrt{4 \cdot 39}$$

$$a = 2\sqrt{39}$$

Now just remember that this was originally labeled as side c, so we need to change back the variable.

$$c = 2\sqrt{39}$$

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